1277 Issued August 29, 1910.

U. S. DEPARTMENT OF AGRICULTURE.

FARMERS' BULLETIN 412.

Experiment Station Work, LVIII.

Compiled from the Publications of the Agricultural Experiment Stations.

FERTILIZERS FOR PINEAPPLES.
WART DISEASE OF THE POTATO.
THE TYPHOID OR HOUSE FLY.
RICE AND ITS BY-PRODUCTS AS FEEDING STUFFS.
THE FORCED MOLTING OF FOWLS.
A PORTABLE PANEL FENCE.
PASTEURIZATION IN BUTTER MAKING.
MILLING AND BAKING TESTS WITH DURUM WHEAT.

MAY, 1910.

PREPARED IN THE OFFICE OF EXPERIMENT STATIONS.
A. C. TRUE, Director.

WASHINGTON:
GOVERNMENT PRINTING OFFICE.
1910.

THE AGRICULTURAL EXPERIMENT STATIONS.

ALABAMA—
College Station: *Auburn;* J. F. Duggar.[a]
Canebrake Station: *Uniontown;* F. D. Stevens.[a]
Tuskegee Station: *Tuskegee Institute;* G. W. Carver.[a]
ALASKA—*Sitka:* C. C. Georgeson.[b]
ARIZONA—*Tucson:* R. H. Forbes.[a]
ARKANSAS—*Fayetteville:* C. F. Adams.[a]
CALIFORNIA—*Berkeley:* E. J. Wickson.[a]
COLORADO—*Fort Collins:* C. P. Gillette.[a]
CONNECTICUT—
State Station: *New Haven;* E. H. Jenkins.[a]
Storrs Station: *Storrs;* L. A. Clinton.[a]
DELAWARE—*Newark:* Harry Hayward.[a]
FLORIDA—*Gainesville:* P. H. Rolfs.[a]
GEORGIA—*Experiment:* Martin V. Calvin.[a]
GUAM—*Island of Guam:* J. B. Thompson.[b]
HAWAII—
Federal Station: *Honolulu;* E. V. Wilcox.[b]
Sugar Planters' Station: *Honolulu;* C. F. Eckart.[a]
IDAHO—*Moscow:* W. L. Carlyle.[a]
ILLINOIS—*Urbana:* E. Davenport.[a]
INDIANA—*Lafayette:* A. Goss.[a]
IOWA—*Ames:* C. F. Curtiss.[a]
KANSAS—*Manhattan:* E. H. Webster.[a]
KENTUCKY—*Lexington:* M. A. Scovell.[a]
LOUISIANA—
State Station: *Baton Rouge.*
Sugar Station: *Audubon Park, New Orleans.*
North Louisiana Station: *Calhoun.*
Rice Experiment Station: *Crowley;* W. R. Dodson (*Baton Rouge*).[a]
MAINE—*Orono:* C. D. Woods.[a]
MARYLAND—*College Park:* H. J. Patterson.[a]
MASSACHUSETTS—*Amherst:* W. P. Brooks.[a]
MICHIGAN—*East Lansing:* R. S. Shaw.[a]
MINNESOTA—*University Farm, St. Paul:* A. F. Woods.[a]
MISSISSIPPI—*Agricultural College:* J. W. Fox.[a]
MISSOURI—
College Station: *Columbia;* F. B. Mumford.[a]
Fruit Station: *Mountain Grove;* P. Evans.[a]
MONTANA—*Bozeman:* F. B. Linfield.[a]
NEBRASKA—*Lincoln:* E. A. Burnett.[a]
NEVADA—*Reno:* J. E. Stubbs.[a]
NEW HAMPSHIRE—*Durham:* J. C. Kendall.[a]
NEW JERSEY—*New Brunswick:* E. B. Voorhees.[a]
NEW MEXICO—*Agricultural College:* L. Foster.[a]
NEW YORK—
State Station: *Geneva;* W. H. Jordan.[a]
Cornell Station: *Ithaca;* H. J. Webber.[c]
NORTH CAROLINA—
College Station: *West Raleigh;* C. B. Williams.[a]
State Station: *Raleigh;* B. W. Kilgore.[a]
NORTH DAKOTA—*Agricultural College:* J. H. Worst.[a]
OHIO—*Wooster:* C. E. Thorne.[a]
OKLAHOMA—*Stillwater:* B. C. Pittuck.[c]
OREGON—*Corvallis:* J. Withycombe.[a]
PENNSYLVANIA—
State College: T. F. Hunt.[a]
State College: Institute of Animal Nutrition; H. P. Armsby.[a]
PORTO RICO—*Mayaguez:* D. W. May.[b]
RHODE ISLAND—*Kingston:* H. J. Wheeler.[a]
SOUTH CAROLINA—*Clemson College:* J. N. Harper.[a]
SOUTH DAKOTA—*Brookings:* J. W. Wilson.[a]
TENNESSEE—*Knoxville:* H. A. Morgan.[a]
TEXAS—*College Station:* H. H. Harrington.[a]
UTAH—*Logan:* E. D. Ball.[a]
VERMONT—*Burlington:* J. L. Hills.[a]
VIRGINIA—
Blacksburg: S. W. Fletcher.[a]
Norfolk: Truck Station; T. C. Johnson.[a]
WASHINGTON—*Pullman:* R. W. Thatcher.[a]
WEST VIRGINIA—*Morgantown:* J. H. Stewart.[a]
WISCONSIN—*Madison:* H. L. Russell.[a]
WYOMING—*Laramie:* H. G. Knight.[a]

[a] Director. [b] Special agent in charge. [c] Acting director.

EXPERIMENT STATION WORK.

Edited by W. H. BEAL and the Staff of the Experiment Station Record.

Experiment Station Work is a subseries of brief popular bulletins compiled from the published reports of the agricultural experiment stations and kindred institutions in this and other countries. The chief object of these publications is to disseminate throughout the country information regarding experiments at the different experiment stations, and thus to acquaint farmers in a general way with the progress of agricultural investigation on its practical side. The results herein reported should for the most part be regarded as tentative and suggestive rather than conclusive. Further experiments may modify them, and experience alone can show how far they will be useful in actual practice. The work of the stations must not be depended upon to produce "rules for farming." How to apply the results of experiments to his own conditions will ever remain the problem of the individual farmer.—A. C. TRUE, Director, Office of Experiment Stations.

CONTENTS OF NO. LVIII.

ILLUSTRATIONS.

EXPERIMENT STATION WORK.[a]

FERTILIZERS FOR PINEAPPLES.[b]

For a number of years the Florida Experiment Station has been actively engaged in determining what fertilizer combinations will develop the best yield, quality, and shipping properties in pineapples. The experiments have been carried on with pineapples grown under sheds, which is the usual method of culture in the older pineapple sections. The initial work along this line conducted during the winter of 1897–8[c] was reported by P. H. Rolfs in 1899, and his results were later embodied in a Farmers' Bulletin of this Department.[d] A more extended series of experiments was started in 1901 in which some ninety-six variations and combinations of the fertilizers commonly used for pineapples were tested, the quantity applied per acre ranging from 2,250 pounds to 4,500 pounds.

H. K. Miller and A. W. Blair reporting on the effects of these different fertilizers for the first three seasons found that acid phosphate had an injurious effect upon pineapples, which could be corrected by the use of lime. They attributed the injury to the sulphate of iron and aluminum which the acid phosphate contained, since phosphoric acid derived from boneblack did not have any injurious effect on the plants. Growers were recommended as a general rule to rely upon bone meal or slag as sources of phosphoric acid.

If acid phosphate is used lime should be added every year or two, at the rate of about 750 pounds to the acre. * * *

As sources of nitrogen, dried blood, cotton-seed meal, and castor pomace may be used. Nitrate of soda may be used for the first six months and possibly, to a limited extent, for the first year, but after the first year it will probably be safer to eliminate it entirely. Considerable caution is required in its use, * * * [for] nitrate of soda when used in sufficient quantity to furnish

---

[a] A progress record of experimental inquiries, published without assumption of responsibility by the Department for the correctness of the facts and conclusions reported by the stations.

[b] Compiled from Florida Sta. Buls. 83, 101.

[c] Florida Sta. Bul. 50.

[d] U. S. Dept. Agr., Farmers' Bul. 140.

all the nitrogen proves injurious both to the plants and to the shipping qualities of the fruit. * * *

Of the potash salts used, high and low grade sulphate have given the best results, the latter seeming slightly the better. Muriate has given fair results, though the sulphate undoubtedly gives better results. Kainit should not be used. High grade tobacco stems, though not used in this experiment, have been used by a number of growers with good results.

On the whole the best results were obtained by the use of about 3,750 pounds per acre of a fertilizer, analyzing 4 per cent available phosphoric acid, 5 per cent nitrogen, and 10 per cent potash. By increasing the fertilizer from a little more than a ton to nearly 2 tons per acre, the number of larger sizes of pineapples was increased to a very profitable extent. There appeared to be no advantage in using more than 2 tons per acre.

The bulk of Florida pines are grown along the east coast. Relative to the use of fertilizers in this section the above writers say:

For most of the east coast soils we would recommend 3,500 to 4,000 pounds to the acre annually of a fertilizer analyzing 4 per cent available phosphoric acid, 5 per cent nitrogen, and 10 per cent potash, to be applied at the rate of four applications a year for the first eighteen months, and after this two applications a year; one in February or March, as the conditions may require, and one soon after the removal of the summer crop. However, some very successful growers recommend three applications a year, as follows: About 1,400 pounds of a standard fertilizer in February and again after the removal of the summer crop, and 1,000 to 1,200 pounds high-grade tobacco stems in the fall or early winter. A regular application of a growing fertilizer at the beginning of winter has been found objectionable, in that plants, if started to growing rapidly, are much more susceptible to injury by the cold weather which may come in January or February. This was clearly demonstrated by the freeze in 1905. Those who fertilized heavily in the late fall suffered more than those who did not fertilize at this time or who used only ground tobacco stems. The tobacco does not cause much growth, but makes the plants hardy, and thus better able to stand the cold.

Within three weeks, or as soon as possible after setting out, the plants should have a light application of cotton-seed meal in the bud, about a tablespoonful to the plant. The first regular application should be put on broadcast about six weeks later, and be thoroughly worked in with the scuffle hoe. For this application, some growers have used castor pomace or cotton-seed meal, and high-grade tobacco stems, with good results.

The Florida experiments were continued for the purpose of finding out whether the quality of pineapples is affected by the kind or quantity of the fertilizer used, chemical analyses being made of fruits from the various plats during the four seasons.

This work as reported by A. W. Blair and R. N. Wilson in a recent bulletin of the Florida Station shows that the eating quality of the fruit when gauged by the sugar and acid content of the juice does not appear to be influenced by the kind of fertilizer used. Increasing the amount of fertilizer per acre slightly increased the sugar

content and very slightly decreased the acid in the fruit. The work did not show, however, to which particular fertilizer constituent these changes are due.

Although the average weight of the fruit varies from season to season the large fruits appear to contain a greater percentage of sugar and a slightly smaller percentage of acid than the small ones.

The nitrogen content of the fruit does not appear to increase with an increase of fertilizer.

Averages based upon the analyses reported in the bulletin show the edible portion to be 61 per cent of the whole fruit and the available juice to be 92.84 per cent of the edible portion. The juice contains 12.07 per cent total sugars and the equivalent of 0.98 per cent of citric acid.

The results of this work as a whole would seem to indicate that liberal fertilizing within certain limits materially increases the size of the fruit and also improves the quality to a certain extent. Each grower must learn from experience what methods of culture and kind of fertilizer is best suited to his local conditions. The use of fertilizers which have been shown to be harmful can be avoided, however, and the formula as worked out by the station should serve as a valuable guide for the inexperienced grower. The experiments reported on were conducted with shed-grown pines, which it is generally conceded do not require so much fertilizer as those grown in the open; hence, it is suggested that the amount to be used in the open might be profitably increased beyond the amount specified for sheds.

WART DISEASE OF THE POTATO.[a]

During the past thirteen years a serious fungus disease of potatoes has spread throughout European countries. It was first recorded from Hungary in 1896 and appeared in England in 1901, and is known as the "black scab," "warty disease," "cauliflower disease of potatoes," and "potato canker." During the years that have elapsed since the disease first became known it has spread into Ireland, Scotland, England, Scandinavia, Germany, France, Italy, and Newfoundland, and is prevalent over the greater part of Europe. In England alone 244 cases have been reported to the authorities under the new act. It was not known on the American Continent until it made its appearance in Newfoundland in 1909. The extraordinary virulence of the disease in Great Britain and the rapidity with which it has spread make it necessary to warn all potato growers to be on the

[a] Compiled from Canada Cent. Expt. Farm Bul. 63; Sci. Proc. Roy. Dublin Soc., n. ser., 12 (1909), No. 14, p. 131. See also U. S. Dept. Agr., Bur. Plant Indus. Circ. 52.

lookout for this disease. Where allowed to establish itself it renders the cultivation of potatoes extremely difficult, as they can not be raised on that ground for a period of at least six years. Therefore, stringent preventive measures should be used to keep this disease out of the United States. By the terms of the "Destructive insect and pests order of 1908" in England, Scotland, and Wales, persons concealing this disease are liable to prosecution and a heavy penalty.

It is believed that the disease is likely to be introduced into the United States at any time. In order that the disease may be recognized and promptly reported it is fully described by H. T. Güssow in a bulletin of the Central Experimental Farm of Canada and by W. A. Orton in a circular of the Bureau of Plant Industry of this Department.

Where the disease is prevalent no healthy tubers will develop. When lifted they will show various degrees of injury. The first indication of the disease may be noticed around the eyes of the potato, which show an abnormal development of the dormant shoot. In this condition the disease is liable to escape detection, and thus be spread by the use of infected tubers as seed. In the earlier stages of the disease the eye will be found slightly protruding in the form of a single or compound group of small nodules, varying from the size of a pin head to that of a pea. (See fig. 1.) The gray surface of the swollen eye is dotted over with golden-yellow rings, as seen with a pocket lens. Some tubers will be found, when the crop is harvested, with more or less than one-half of them covered by these warty excrescences, which in some instances are larger than the tuber itself. This warty growth consists of a coral-like mass, of more or less scaly excrescences (see figs. 2 and 3), similar in appearance to the well-known crown or root gall of apples. The warts are of a somewhat lighter color at the base and dotted with minute rusty brown spots over the surface. In advanced stages, the tubers are wholly covered with this growth, and have lost every semblance to potatoes. (See fig. 3.) A still more advanced stage occurs when the fungus has utilized every particle of food stored in the potato and has reduced it to a brownish-black soft mass, giving off a very unpleasant putrid odor. This is the most dangerous stage of the disease, as tubers which

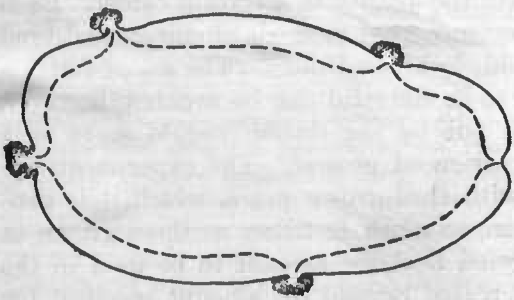

FIG. 1.—A potato tuber showing eyes attacked by wart disease.

have reached it can not be harvested whole. They break in pieces and thus the brownish pulpy mass, consisting almost entirely of the

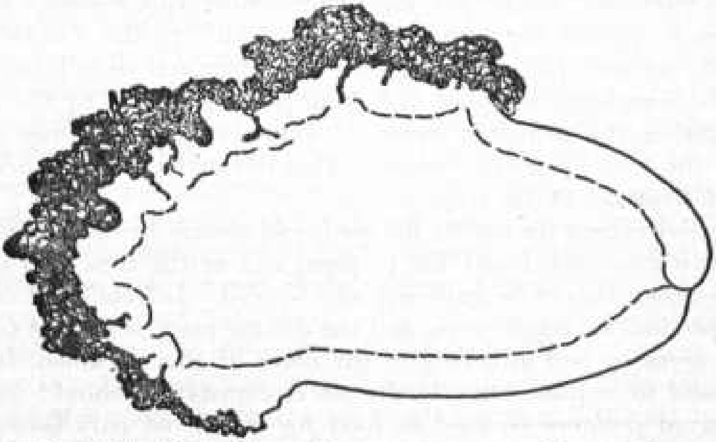

FIG. 2.—Potato tuber half covered by excrescences caused by wart disease.

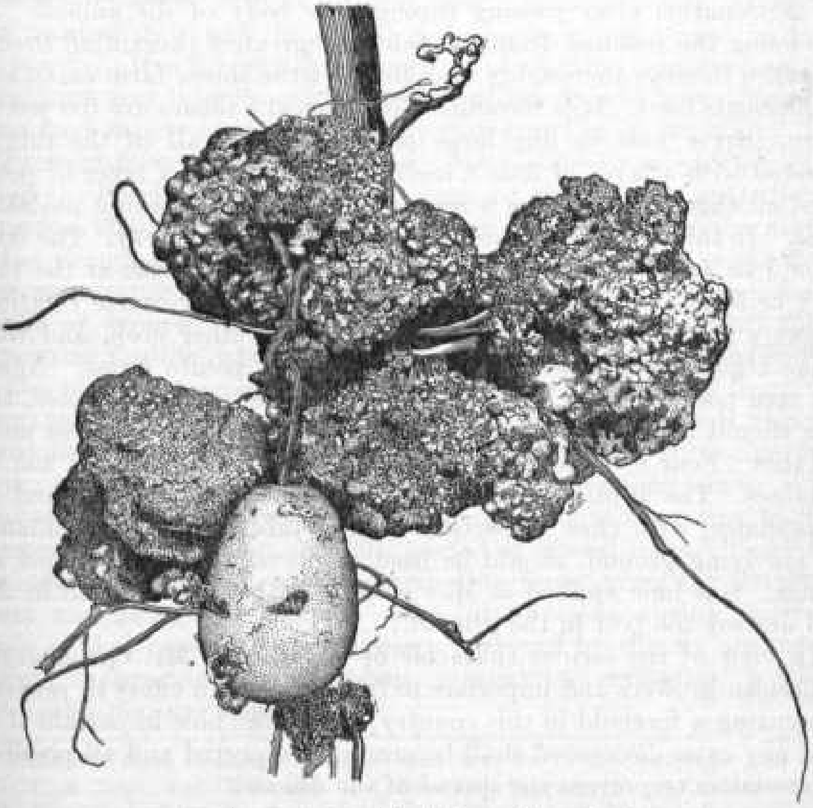

FIG. 3.—Potato plant attacked by wart disease.

spores of the fungus and remains of the cell walls of the potato, is broken up and the land is badly infected for years. The wart is a

wrinkled proliferation or corrugation of the flesh of the tuber, due to excessive cell division caused by the stimulating presence of the fungus parasite. In the last stages, the whole wart becomes more or less black, giving the term of "black scab" to the disease. The parasite not only passes through the host from cell to cell, but it also spreads from tuber to tuber and from plant to plant, by the formation during the growing season of summer swarm spores. These attack the healthy potato tissues. This disease is often so prevalent as to destroy the entire crop.

Diseased tubers are not fit for seed, and should be either destroyed by burning or boiled and fed to pigs, and as the tops also may be diseased they should be gathered and burned. Infected soil will for years produce unsound crops, and the disease may be carried to uninfected areas by soil adhering to the boots of the workmen, to farm carts, and to implements. Under no circumstances should unboiled or decayed potatoes be used as food for stock, not only because the feeding value is reduced, but mainly because the spores are capable of germination after passing through the body of the animal. In removing the potatoes from the field, the greatest precaution should be taken to clean thoroughly and disinfect the shoes, farm carts, and implements used. It is recommended when the tubers are too wet to burn, that a hole be dug large enough to hold all of the tubers, covered with a layer of lime 6 inches deep, and then a layer of potatoes, another layer of lime 6 inches deep, and so on, using unslaked lime. In this manner the tubers are put out of harm's way. The land should be fallowed and then treated with unslaked lime at the rate of 4 or 5 tons per acre. In fields worked on a four-course rotation, growers should replace the potatoes by some other crop, and thus make eight years between the two successive potato crops. Never use seed potatoes from a diseased crop. If the seed is suspected, the sets should be powdered with sulphur and be stored in boxes until planted. Four or 5 pounds of sulphur is sufficient to treat 1 ton of potatoes. The application of kainit or other potash-manure and of phosphates, with close inspection of seed tubers and the avoidance of low-lying ground, should be used to prevent a recurrence of an attack. Gas lime applied in May or June and sulphur mixed in the soil destroy the pest in the ground.

In view of the serious character of the disease, Mr. Orton urges American growers and importers to cooperate in an effort to prevent it securing a foothold in this country, and shows how important it is that any cases discovered shall be promptly reported and all possible means taken to prevent the spread of the disease.

THE TYPHOID OR HOUSE FLY.[a]

Much has been written during the last few years calling attention to the danger that lurks in the presence of that common household pest, the house fly. In order to emphasize the importance of this fly as a disseminator of disease germs, Dr. L. O. Howard, chief of the Bureau of Entomology of this Department, has given to it the name typhoid fly, which name has now come into quite common use. This fly of world-wide distribution is perhaps the one most important insect pest known to man. As a direct pest it is a source of great annoyance, necessitating, with the mosquito, an estimated annual expenditure in the United States alone of more than $10,000,000 for the screening of habitations. But the importance of this fly as an annoying pest is insignificant compared with its importance as a menace to public health through the dissemination of disease germs. In the maggot stage the fly thrives in all kinds of filth and as adult it feeds upon similar materials, thus ingesting the deadly germs of enteric diseases, such as typhoid fever, cholera, cholera infantum, and tropical dysentery, to deposit them hours, or even days, later in fly specks, often on various articles of food; or these microscopic organisms may be collected on the feet of the fly and later adhere to some food supply over which the fly may crawl in its travels.

Typhoid fever is one of the most serious ailments to which man is subject. There are about 250,000 cases of this disease annually in America, about 35,000 proving fatal. Sixty per cent of the deaths in the Franco-Prussian war and 30 per cent of the deaths in the Boer war were caused by this disease. One investigator has found the bacilli of typhoid fever in the dejecta of house flies twenty-three days after feeding, while another records the presence of this bacillus in flies during a period of two weeks. The possibilities of transmitting typhoid fever are appalling to the layman, when it is remembered that the germs of this disease may be in the system several weeks before diagnosis is possible, continue in numbers six or eight weeks after apparent recovery, and in exceptional cases may be discharged from the system during a period of several years. There are authentic records of a patient distributing these germs for seventeen years and being the incipent cause of 13 cases during fourteen years of that period. Other diseases conveyed by this fly are tuberculosis, anthrax, plague, trachoma, septicemia, erysipelas, leprosy, yaws, and perhaps smallpox.

[a] Compiled from Connecticut Storrs Sta. Bul. 51, p. 95; Maryland Sta. Bul. 134; U. S. Dept. Agr., Bur. Ent. Bul. 78; Circ. 71, rev.; North Carolina Dept. Agr., Ent. Circ. 25; Jour. Econ. Ent., 2 (1909), No. 1, p. 39; Reprint from Cal. Jour. Technol., 14 (1909), No. 2; Bul. Berkeley, Cal., Bd. Health, 1909, June 29.

The experiments of an Italian investigator have shown that the eggs of tapeworms and several other intestinal worms pass uninjured through the alimentary tract of flies. The larvæ or maggots are also the cause of diarrhea and other intestinal disturbances in children.

In regard to the importance of the house fly, Symons, of the Maryland Experiment Station, says:

It is well known that the germ of typhoid fever may be in the human system several weeks before it is detected and also for several weeks after all symptoms have disappeared and the patient [is] apparently well. The excreta of such persons, which may be in an open privy, or in many cases in country districts located anywhere around the outbuildings, is visited by the fly, whose feet and body are particularly adapted to carrying germs. This same fly after visiting such places may immediately return to the house of the sick or that of a neighbor and be seen crawling in the kitchen or dining room over the food that is prepared to be eaten by the unaffected persons. Not only may the fly disseminate the disease to the healthy within the family of the sick or that of close-by neighbors, but there is every opportunity for the same infected fly to visit the village or city store where foods are exposed and thus spread the disease to those families who purchase them. The butcher wagon of the country or the trolley or express train carrying food such as sacked meat, etc., may easily become factors in the dissemination of this disease if such carriers are loaded at or visit points where conditions are favorable for visitation by infested flies. The house fly is connected with the dissemination of intestinal diseases other than typhoid fever. Doctor Jackson, of New York, points out that the immunity from diarrhea of breast-fed babies and the frequency of its occurrence among artificially fed babies indicates strongly the food as a medium of transmission, and further states that in his extended study of this problem along the water front of New York City during 1907, he found that the prevalence of these diseases among children and adults corresponded to the prevalence of flies. Further, Doctor Felt, in a recent paper, states that "it is well known that flies feed upon sputum. Experiments by Lord, recorded in the Boston Medical and Surgical Journal, show that flies may ingest tubercular sputum and excrete tubercular bacilli, the virulence of which may last for at least fifteen days. He considers the danger of human infection from this source to lie in the injection of fly specks on food, and suggests that during the fly season great attention should be paid to the screening of rooms and hospital wards containing patients with tuberculosis and laboratories where tubercular material is examined."

In an investigation of the sources of bacteria in milk, Esten and Mason, of the Connecticut Storrs Station, studied the bacterial population of 414 flies and conclude that the domestic fly is a dangerous enemy to human health.

The numbers of bacteria on a single fly may range all the way from 550 to 6,600,000. Early in the fly season the numbers of bacteria on flies are comparatively small, while later the numbers are comparatively very large. The place where flies live also determines largely the numbers that they carry. The average for the 414 flies was about one and one-fourth millions bacteria on each. It hardly seems possible for so small a bit of life to carry so large a number of organisms. The method of the experiment was to catch the flies from the several sources by means of a sterile fly net, introduce them into a sterile bottle, and pour into the bottle a known quantity of sterilized water,

then shake the bottle to wash the bacteria from their bodies, to simulate the number of organisms that would come from a fly in falling into a lot of milk. * * * The objectionable class, coli-aerogenes type, was two and one-half times as abundant as the favorable acid type. If these flies stayed in the pig-pen vicinity there would be less objection to the flies and the kinds of organisms they carry, but the fly is a migratory insect and it visits everything "under the sun." It is almost impossible to keep it out of our kitchens, dining rooms, cow stables, and milk rooms. The only remedy for this rather serious condition of things is, remove the pigpen far as possible from the dairy and dwelling house. Extreme care should be taken in keeping flies out of the cow stable, milk rooms, and dwellings. Flies walking over our food are the cause of one of the worst contaminations that could occur from the standpoint of cleanliness and the danger of distributing disease germs.

Epidemics of intestinal diseases among infants fed with cow's milk appear to be caused more often by flies than any other source. Milk comes to cities from rural districts where the principles of sanitation are not applied. This fact points to the necessity of handling milk, especially during hot weather, with great care and cleanliness. The use of clean milk in a community always lowers the infant death rate.

Another preventive measure is to keep milk clean through its entire course from cow to consumer. Also to keep it cool and always away from flies. All sewer openings on private or public property should have blind openings of such a nature that it would be impossible for flies to visit them. All refuse from dwellings should be disposed of in such a manner that no flies could get at it. Manure heaps are the most luxurious media for the multiplication of flies. Manure should never be piled near a dairy or dwelling. Its best disposition is to work it into the soil [as] soon as possible during the summer months.

While there are several species of flies which are commonly found in houses, but one of these should be called the house fly proper. This species has been found by Doctor Howard to compose 98.8 per cent of the whole number of insects captured in houses throughout the whole country. It has been shown that this fly, while breeding most numerously in horse stables, is also attracted to human excrement and will breed in this substance. Kitchen refuse, dooryard rubbish, cracks in the stable and stall floors where manure falls between, but which can easily be remedied by the use of cement, stable yards and town lots used for horses, and unused brewers' grains and mash dumped as waste are other places where this prolific fly will breed and which should be removed in the campaign against it. In a campaign conducted at Berkeley, Cal., Herms, of the California Experiment Station, found that in one instance a fly nuisance was due to the habit of the maggots of leaving the manure pile in four or five days and burrowing into the soil beneath or crawling into near-by cracks and crevices, thus escaping removal with the weekly collection. An estimate was made of the number of full-grown or nearly full-grown larvæ in a manure pile after an exposure of four days. In 15 pounds of manure, samples taken from five different parts, a total of 10,282 maggots was counted. The estimated weight of this entire pile of

manure was 1,000 pounds, of which surely two-thirds was infested, thus giving the total of over 455,000 maggots for this one manure pile.

Symons, of the Maryland Station, gives the following account of the life history of the fly:

The common house fly (*Musca domestica*) is a medium-sized fly, grayish in color, with its body somewhat streaked with blackish gray. As previously mentioned, its body, but more especially its legs and feet, are covered with minute hairs. Its mouth parts are formed for lapping and not biting, yet many people think of the house fly as being able to bite. This is no doubt due to the presence in the houses of one of the stable flies, whose mouth parts are formed for piercing. The insect winters in the adult state, hiding in houses or out-of-the-way places. At the approach of warm weather the flies come forth from their hiding places and commence to lay their tiny white eggs. These eggs commonly are deposited in horse manure, as this seems to be the preferred larval food, and it is from this source that the majority of the house flies come. Eggs may also be laid in human excreta and in decayed vegetable and animal matter. Doctor Howard found in midsummer in the vicinity of Washington that a female fly lays about 120 eggs, which hatch in about eight hours. The white larvæ or maggots, which are pointed at one end and blunt at the other, grow rapidly and change to a pupa in four or five days, the adult emerging from the pupa in about five days, thus completing their life history in about ten days. Howard states that "there is abundance of time for the development of twelve or thirteen generations in the climate of Washington every summer."

Herms, of the California Station, is authority for the statement that "the fly does not of its own accord travel far from its breeding place, probably not more than a block or two, which simplifies matters of control."

In the house a 5 to 8 per cent solution of formaldehyde sweetened with sugar, honey, or the like, and placed in shallow vessels on window sills and tables serves as a good substitute for arsenical and cobalt fly poisons. Permanent preventive measures are, however, far less expensive in the end and much more effective than the use of temporary methods. Where many horses are stabled, a closet to receive manure can be built at a small cost. Such a closet must be kept closed, except when the stable refuse is being placed in it or is being removed. The effectiveness of fly-tight manure receptacles has been demonstrated beyond question. A form of manure bin described by Herms, of the California Station, which is simple in its construction, but effective, and which can be placed outside the stable, is shown in the accompanying illustration. The refuse is removed from the bin by lifting up the front hinged door (fig. 4). Ventilation is secured by means of screened openings in either end. Where there are no sliding doors to obstruct a more practical receptacle may be constructed in the form of a low lean-to, with a small screen door connecting it with the stable, through which the manure may be thrown into the shed, and also providing for ventilation. An outer

door, such as is shown in the figure, would give access for the removal of the refuse.

Where only one horse is stabled the manure may be conveniently placed in ordinary garbage cans and stamped down, or in tight barrels covered over with a well-fitting lid or wire screen. * * * On the farm or ranch it is often possible, and certainly advisable, to remove the stable manures every morning merely by backing the cart to the stable door and depositing therein the material and hauling it to the field at once, where it is scattered. The manure should in all cases be scattered upon the field and not be allowed to accumulate there in heaps. Thinly scattered manure does not favor the breeding of flies, because of lack of moisture.

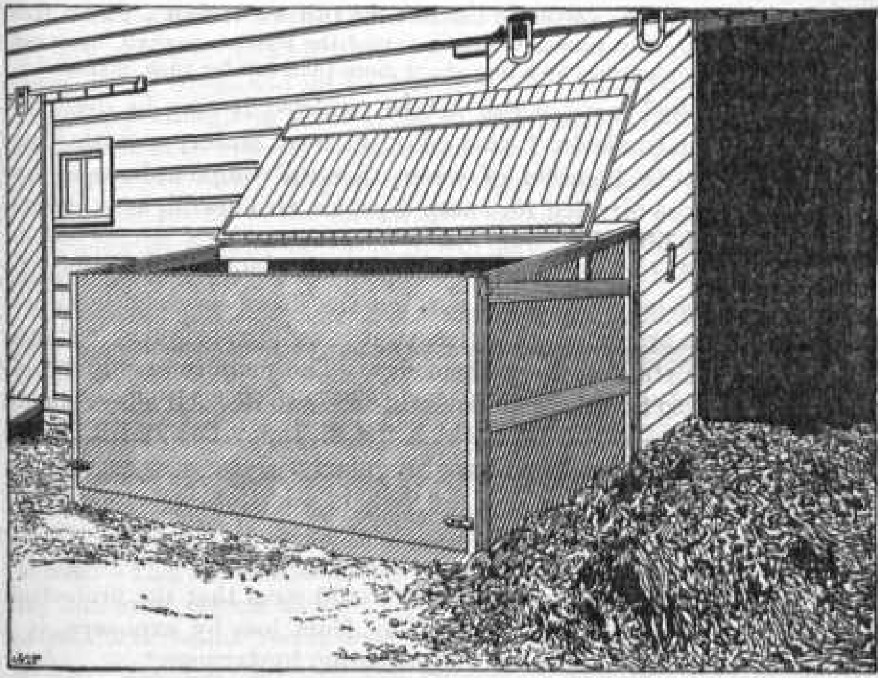

FIG. 4.—Closed receptacle for refuse to prevent breeding of flies.

Many cities and towns are now conducting campaigns against the house fly, and this number is rapidly increasing. A series of rules formulated in 1906 by the health department of the District of Columbia has been briefly summarized by Doctor Howard, as follows:

All stalls in which animals are kept shall have the surface of the ground covered with a water-tight floor. Every person occupying a building where domestic animals are kept shall maintain, in connection therewith, a bin or pit for the reception of manure, and, pending the removal from the premises of the manure from the animal or animals, shall place such manure in said bin or pit. This bin shall be so constructed as to exclude rain water, and shall in all other respects be water-tight except as it may be connected with the public sewer. It shall be provided with a suitable cover and constructed so as to pre-

vent the ingress and egress of flies. No person owning a stable shall keep any manure or permit any manure to be kept in or upon any portion of the premises other than the bin or pit described, nor shall he allow any such bin or pit to be overfilled or needlessly uncovered. Horse manure may be kept tightly rammed into well-covered barrels for the purpose of removal in such barrels. Every person keeping manure in any of the more densely populated parts of the District shall cause all such manure to be removed from the premises at least twice every week between June 1 and October 31, and at least once every week between November 1 and May 31 of the following year. No person shall remove or transport any manure over any public highway in any of the more densely populated parts of the District except in a tight vehicle which, if not inclosed, must be effectually covered with canvas, so as to prevent the manure from being dropped. No person shall deposit manure removed from the bins or pits within any of the more densely populated parts of the District without a permit from the health officer. Any person violating any of the provisions shall, upon conviction thereof, be punished by a fine of not more than $40 for each offense.

In case infested manure can not be removed it may be drenched with a kerosene emulsion, 1 part of oil to 10 of water, or with Paris green, 2 ounces to 1 gallon of water. Cresol compounds, used five times as strong as directed for sheep dips, are also useful, as is chlorid of lime if used liberally.

The floors of stables should be made smooth and hard, so that the manure can not only be forked out, but the floors thoroughly swept. After the floors are thoroughly cleaned it is well to sprinkle air-slaked lime about the stalls to keep them dry. The manure should be removed at once, so that flies can not gain access to it. All alleys should be kept free from rubbish, in which the flies may be; and it is also important that garbage be collected regularly.

The above facts make it evident that, in addition to being a very wasteful method of handling fertilizing material, the ordinary exposed barnyard manure heap is a breeding place for a frightful nuisance and menace to health, and it would seem that the protection of the manure against flies, as well as from loss by exposure, is a matter well worthy of more serious attention by farmers.[a]

RICE AND ITS BY-PRODUCTS AS FEEDING STUFFS.[b]

With the rapid extension of the rice-growing area in the Southern States and the increase in price of corn and other feeds, rice and its by-products have become of considerable importance in making up rations for live stock.

---

[a] A cheap lean-to shelter, described in U. S. Dept. Agr., Farmers' Bul. 192 might be made to accomplish both these purposes.

[b] Compiled from Alabama Sta. Bul. 122; Louisiana Stas. Buls. 77, 115; Feed Stuffs Rpt. 1908-9, pp. 6, 7; North Carolina Sta. Bul. 169; South Carolina Sta. Bul. 55; Texas Sta. Buls. 73, 76, 86; U. S. Dept. Agr., Farmers' Bul. 110; Hawaii Sta. Rpt. 1908, pp. 51-58.

Many farmers feed rice in the sheaf with good results. Rough rice as it comes from the thrashing machine when added to a ration of cotton-seed meal, cotton-seed hulls, and alfalfa hay in a steer-feeding experiment at the Texas Experiment Station, produced slightly larger gains in weight, but at an increased cost. If the rice had been worth only $10 per ton, the cost of gain would have been the same either with or without the rice. W. R. Dodson, of the Louisiana Experiment Station, estimates that 162 pounds of rough rice, or paddy, as it is sometimes called, are about equivalent in feeding value to 174 pounds of corn, and at present prices it should return $2 per barrel when fed to steers under favorable conditions. The experience of practical farmers shows that both white and red rice are valuable feeding stuffs for work horses and mules, fattening steers, dairy cows, and swine, but that the best grades of white rice are often too high in price to be so utilized. As a rule, low-grade rice and broken rice are worth more to feed out than to market at the low prices which they usually bring. "Market your low-grade rice on the hoof," is the advice of a practical farmer who has had experience in feeding it. But it will pay to feed the higher grades to stock only in an era of low prices.

Rice straw.—Rice straw as a stock feed is about equal to that of good southern prairie hay. It contains on an average 4.72 per cent crude protein, 32.21 per cent carbohydrates, and 1.87 per cent fat. The sweetness and excellent flavor of well-preserved rice straw adds materially to its feeding value, because the stock will consume large quantities of it.

Milling products of rice.—Rough rice consists of the grain proper with its close-fitting cuticle roughly inclosed by the stiff, hard husk, or hull. The object of milling is to produce clean rice by removing the hull and cuticle and to polish the surface of the grain. The by-products which result from milling consists of hulls, bran, and polish. One bag of rice (162 pounds) should produce about 100 pounds clean rice, 7 pounds rice polish, 20 pounds rice bran, and 35 pounds chaff or hulls. Grits or broken grains of rice are found in the bran and polish. C. A. Brown, in a bulletin of the Louisiana Station, says that—

In some cases 25 per cent of the feed consists of grits; the varying amounts of these in the rice feeds naturally cause a fluctuation in the composition, a large quantity of grist causing an increase in starch and a decrease in protein and fat. While the grits have a high feeding value, and are not particularly detrimental to the animal, as is the case with rice hulls, it must be noted that many of them pass through the animal undigested. These fragments of rice are very hard to break up and are not easily affected by the digestive juices of the animal. Nearly 10 per cent of the dry matter in the excrement

of an animal fed with polish consisted of undigested grits. If these grits could be ground up, or if they could be removed during milling, the digestibility of the feed would be increased.

Rice meal should consist of pure rice bran, but as usually found on the market it is a mixture of bran, polish, and hulls, and hence varies so much in composition that its feeding value is problematical without a guaranteed chemical analysis.

Rice hulls.—Rice hulls are the outer coating of the grain, and are composed mainly of fiber and mineral matter. They are worthless as a feed, and when fed in large quantities are positively harmful. Rice hulls are often used for adulterating molasses and other mixed feeds. Considerable quantities are also ground and sold as "husk meal" or "star bran." At the Texas Station an attempt was made to substitute rice hulls for cotton-seed hulls, but the cattle would not eat a sufficient quantity, and the ration finally selected consisted of rice hulls, cotton-seed hulls, cotton-seed meal, and rice bran. The average daily gain was 1.86 pounds, at a cost of 4.35 cents. On a similar ration, without the rice hulls, the average values were 2.17 pounds, at 4.6 cents.

Rice bran.—Rice bran consists of the outer layer of the rice kernel, together with some of the germ, and in a pure state is the most nutritious of the rice feeds. Unfortunately commercial rice bran often contains more or less hulls, hence its feeding value varies considerably. Recent analyses at the Louisiana Station showed a variation from 2.47 to 15.13 per cent protein, 1 to 19.19 per cent fat, 31.11 to 54.85 per cent carbohydrates, 6.2 to 34.86 per cent fiber, 6.66 to 21.47 per cent ash. The station has adopted as a standard for a good rice bran 12.5 per cent protein, 10 per cent fat, not over 10 per cent fiber, and not over 9 per cent ash.

A good rice bran as a feeding stuff is somewhat better than corn or corn meal if it smells sweet, but if it becomes rancid because of the decomposition of the fatty material, cattle do not like it. Rancidity can probably be prevented by removing a portion or all of the fat, or by heating the bran to 200° F. soon after milling. Many commercial rice brans, though reaching the guaranty, may be adulterated and be injurious to the animal when the percentage of hulls is high.

Doctor Brown discusses the subject of feeding rice bran as follows:

Rice bran has been fed with considerable success to horses and mules in Louisiana and elsewhere in the South. A few examples of a mixed ration for horses and mules, introducing rice meal, are given below. Such a ration should contain coarse fodder, such as hay, in addition to the concentrates. The general practice is to use the coarse and concentrated feed in about equal proportions. The following rations ought to meet the needs of an ordinary farm mule weighing 1,200 pounds and doing a heavy amount of work:

Ration No. 1.—15 pounds crab-grass hay, 8 pounds corn, 8 pounds rice meal, 1½ pounds cotton-seed meal. If leguminous hays are available, these may be

used instead of cotton-seed meal to supply protein. Ration No. 2.—15 pounds alfalfa hay, 8 pounds rice meal, 2 pounds corn, 8 pounds molasses. Ration No. 3.—15 pounds cowpea hay, 8 pounds rice meal, 8 pounds corn.

The amounts of digestible protein in the above rations approximate 2½ pounds, the amounts of digestible fat and carbohydrates about 15 pounds. These values exceed somewhat the usual practice of American feeders, but are no greater than the standards accepted in France and Germany, and certainly none too large for plantation mules, which are usually very heavily worked. The rations given are, of course, only examples, and can be varied in any number of different ways to suit the convenience of the feeder.

Comparative experiments at the North Carolina Experiment Station in feeding rice bran and wheat bran to dairy cows have demonstrated that rice bran alone, with corn silage as a source of roughage, is inferior to wheat bran, inasmuch as cows lost both weight and milk on the rice ration. Owing to the deficiency of rice bran in protein it is difficult to make a properly balanced ration for milch cows with this feed alone in connection with some kinds of roughage. Experiments at the above-named station show, however, that if this deficiency in protein be made up by adding a little cotton-seed meal to the ration, there is no difference in the feeding value of rice bran and wheat bran, provided the animals relish the feed equally well, which is not always the case. The distaste which farm animals show at times to rice bran was found in our experiments to be due to a rancid condition of the feed.

The following rations containing rice bran are suggested for milch cows:

Ration No. 1.—6 pounds rice bran, 10 pounds sweet potatoes, 20 pounds pea-vine hay. Ration No. 2.—2 pounds cotton-seed meal, 8 pounds corn or corn-cob meal, 4 pounds rice bran, 15 pounds pea-vine hay. Ration No. 3.—3 pounds cotton-seed meal, 8 pounds rice bran, 10 pounds molasses, 14 pounds mixed grass hay.

At the Texas Station rice bran in a steer ration was found inferior to cotton-seed meal. In one test rice bran replaced cotton-seed meal in the proportion of 3:2, and cotton-seed hulls constituted the coarse fodder. The average daily gain per head was 2.17 pounds, and the cost of a pound of gain was 4.6 cents. On cotton-seed meal and hulls the similar values were 2.21 pounds and 4.61 cents. The average daily gain upon rice bran substituted for cotton-seed meal in about the proportion of 2:1 was 2.98 pounds, and the cost of a pound of gain was 3.14 cents, as compared with 2.88 pounds and 3.23 cents on cotton-seed meal and hulls. In another trial, when rice bran was added to a ration of cotton-seed meal and hulls, the quantity of the bran being nearly half that of the meal, the average daily gain was 3 pounds, as compared with 2.6 pounds on cotton-seed meal and hulls only, the cost of a pound of gain in the two cases being 3.9 and 4.1 cents. The following ration is suggested for fattening cattle per thousand pounds live weight: Cotton-seed meal, 3 pounds; rice bran, 8 pounds; molasses, 10 pounds; mixed grass hay, 14 pounds.

Rice bran was not relished by hogs at the Alabama Station, but has been used successfully by feeders in other places. Owing to its

deficiency in protein it should not be fed alone to growing pigs, but should be used with some supplement like skim milk or meat scrap. A ration which may be used per thousand pounds live weight of swine is pure rice bran, 12 pounds; corn, 22 pounds; skim milk, 37 pounds.

Rice polish.—Rice polish is the flour removed from the rice kernel in giving it a pearly luster that the trade demands. It contains less fat and protein than rice bran, but a higher percentage of starch. It is sometimes used as a stuffing material in the manufacture of sausage. A considerable amount of the polish made in this country is exported to Germany, where it is made into buttons. Recent analysis of rice polish showed a variation of 10.13 to 15.50 per cent protein, 4.44 to 14.26 per cent fat, 51.73 to 70.30 per cent carbohydrates, 0.51 to 4.87 per cent fiber.

Rice polish, when substituted for part of the cotton-seed meal in a ration for steers at the Texas Station, resulted in increasing the rate of gain, while the cost of the gain was slightly reduced. The following ration for a steer weighing 1,000 pounds is suggested: Cotton seed 8 pounds, rice polish 4 pounds, alfalfa or pea-vine hay 5 pounds, Johnson grass hay 10 pounds. In five experiments at the Alabama Station rice polish was found superior to corn meal in feeding pigs. One pound of gain required only 3.73 pounds of rice polish, as compared with 4.74 pounds of corn meal. Hence, 78.6 pounds of the polish are equal to 100 pounds of corn meal.

THE FORCED MOLTING OF FOWLS.[a]

The belief is more or less prevalent among poultrymen that if hens are forced to shed their feathers early in the season by partial starvation a larger number of eggs will be produced during the winter than if the hens are allowed to molt naturally. Some who have tried to "force the molt" favor the practice; others condemn it. To test this point the Pennsylvania Experiment Station selected two pens of White Leghorns. Beginning August 13 the hens in one pen were fed a limited grain ration, while those in the other received the normal ration. On August 21 the hens in the first pen were again given a normal amount of feed. Both pens were fed alike from that date. The egg record for September, October, and November showed no benefit from forced molting. "Forced molting seems at first to depress, then increase slightly egg production, but the net results at the end of three months were against forced molting."

These results were less favorable than those obtained at the West

[a] Compiled from New York Cornell Sta. Bul. 258; New York State Sta. Rpt. 1891, p. 194; Pennsylvania Sta. Bul. 87.

Virginia Station, reported in a previous Farmers' Bulletin.[a] At that station it was considered advisable to feed sparingly for about three weeks in August, for then the molt was rapid and the hens entered the winter in better condition.

At the New York State Experiment Station an experiment was made to find what effect a ration containing more than an average amount of fat would have on laying hens. The hens in one pen received as much tallow as was readily eaten with a moderate grain ration. Another lot were fed a similar ration, with linseed meal substituted for the tallow. The average egg production was somewhat in favor of the hens having the linseed meal.

The greatest difference observed was that the hens having the linseed meal molted nearly all at the same time, earlier in the season, and more rapidly. Only a few of the hens which had been fed tallow had begun to molt at the close of this feeding trial, October 6, by which time several hens from the other pen were in new plumage. The tallow ration was apparently too deficient in nitrogen to encourage the growth of new feathers, and the results are in support of the advice to feed during the summer a highly nitrogenous ration to help early molting.

The New York Cornell Experiment Station has published a report of a series of experiments in forced molting, from which the following statements regarding the nature of the feathers and means of forcing of the molt are taken:

While the first body covering of a chick may or may not be called plumage, it is shed and replaced as if it were plumage. The method of molting, however, is peculiar to the downy coat. The baby chick, when it comes from the shell, has pin feathers for flights. In two or three days it develops pin feathers that will become main tail feathers. The down grows longer and on certain areas of the body develops shafts. Within a few days the shafts burst open, allowing the web of the feather to spread out; but the down often clings to the tip of the opened feather. The ragged appearance to be noticed on two or three weeks' old chicks is due to this clinging of the down tips.

The first body feathers to appear are those at the throat, just above the crop. From this point a line of feathers extends down each side of the crop and breast. When this line begins to show, a tuft appears on each thigh and a line down the spine. The feathered areas increase in size as the chick grows older, so that at the age of 4 or 5 weeks they have grown together, and the healthy chick looks to be well feathered. The wings and back are covered, the feathers growing well up the back of the head, and the breast is protected, except a small space over the crop. The rear of the body is covered by the flights, the feathers on the thighs, and a tuft near the rear of the keel bone. The legs are encircled by a ring of feathers just above the shank. In a word, the chick's body is protected by its feathers at every vital point.

It is not generally known whether the chick feathers grow larger with the chick's development or whether they are replaced by new ones; therefore an effort was made to determine this point. A number of chicks, just from the incubator, were leg-banded and their down stained. These chicks were inspected daily for several weeks, and as the feathers appeared an attempt was

[a] U. S. Dept. Agr., Farmers' Bul. 186, p. 27.

made to stain them also. The color took well on the flights and tail feathers, not as well on the body feathers. The first feathers were stained red and those that replaced them were stained black. At the age of 8 weeks all the red feathers in tail and wings had been molted, and at 13 weeks all the black feathers had been replaced by white ones. At the times mentioned the bodies were covered with pin feathers; but this does not prove that these feathers replaced others which had been shed. This sequence of molts corresponds very closely to the sequence of molts in young wild birds.

From 13 weeks to just before maturity (5 to 6 months) the chicks were not observed to molt. They then shed all their feathers and assumed a more mature dress, the pullets apparently getting their full plumage. They lost their chick voice, developed bright red combs, and, to all appearances, were about to begin to lay. The rotation of this molt was nearly the same as the rotation of featherlng in chicks, the oldest feathers being shed first. The wing and tail feathers, which were the first to appear on the chick, were, however, retained until the bird was well along in the molt, and in many cases were not all shed until after the body molt was completed. The time of molting the flights and tail feathers varied in different individuals, but these feathers were usually shed in pairs, one on each wing or corresponding feathers on each side of the tail, as the case might be. The first tail feathers to be shed were usually the middle pair; the first wing feathers to be molted were commonly the last primary or first secondary on each wing, counting from the tip. The last feathers to be replaced were the ones on the inside of the wing just above the primaries and secondaries, a small tuft on the body just in front of the thigh, and the flight coverts.

The pullets appeared to undergo this molt whether they laid or not. After the pullets began to lay they seemed to shed no more feathers so long as they continued in production. When they ceased to lay, many of them began to molt. In some cases the molt was complete, extending to the flights and the tail; in others it went no farther than the body feathers, while in still others it included only a few feathers on different parts of the body.

In former experiments conducted at this station the pullets beginning production before September 1 nearly always molted the entire plumage in the fall. The number of eggs laid before molting did not appear to influence the completeness of the molt. One pullet laid 30 eggs and molted completely; another laid 1 egg and molted just as completely. Some of the pullets which began to lay at a later date continued to lay throughout the winter and spring, not molting until the following regular molting season. One of these laid 230 eggs between molts—about 58 per cent production for the entire time—thirteen months and six days.

The first mature molt comes at the end of the first year of laying. It seems to be a necessary renewal of the worn-out plumage. Feathers, like clothes, wear out.

In the mature molt it was found that the rotation followed closely that of the prenuptial molt before egg production commenced, the oldest feathers being shed first. The mature molt seldom began while the hen was laying. Quite a few feathers might be shed earlier in the season and during production, but in most cases the shedding of feathers ceased for a week or two—often for a much longer period—then the entire plumage was renewed. For convenience, this latter part of the molt is termed the "general molt."

During this molt, some hens shed only a few feathers at a time in the differ ent feather tracts, looking well clothed throughout the molt, while others shed almost the entire plumage at once. The quick shedding gave a good opportu-

nity to observe the feather tracts on a hen. The flight coverts (the small, stiff feathers on the finger of the wing) often persisted long after the other plumage was molted. These feathers, which had been colored, were observed on several hens as late as April following the molt, and were then apparently as firmly fixed as ever.

On August 11, 1906, an attempt to force the molt was made with 232 single comb White Leghorns, by means of restricting the amount of food rather than by changing the quality of the ration.

The starvation period lasted for four weeks. In the first week, the amount of food was gradually reduced to one-half the usual quantity. In the following two weeks about one-third rations were fed, which were gradually increased in the fourth week till, at its close, the flocks which had been starved were given all they would eat.

Three flocks were fed in the usual way and the other flocks were given a similar ration, but in limited quantity.

The experiment continued until November 8, 1907, a period of 455 days.

On the whole, it may be said that from August 25 to October 23 the starved flocks showed a larger percentage of individuals molting. After that time there was more molting among the fed hens, though both flocks completed the molt at about the same time. The molt of the starved flocks was more uniform, and the hens appeared in better physical condition at the end of the molt than the fed hens. This may have been due to the fact that the fed hens had laid more eggs. After all flocks had resumed production there was little, if any, difference in their condition or appearance.

Time required to grow feathers.—It is variously asserted that the time required for the growth of a body feather on a healthy fowl is approximately forty-two days, while the time needed to develop the tail is somewhat longer. This refers to plucked feathers. The usual molting period of a hen can not, however, be accurately calculated from this estimate. In the experiment under consideration the average time of complete molting in the six flocks, containing at the end of the molting season 215 hens, was ninety-five days. The average time required to complete the molt of the 3-year-olds was nearly one hundred and four days; of the 2-year-olds, about one hundred and one days, and of the 1-year-olds, eighty-two days. The starved 1-year-olds averaged to molt more quickly by thirty-three days than did the fed; the starved 2-year-olds were little affected, while the starved 3-year-olds averaged twenty days longer in molting than did the fed birds. The average time required to complete the molt of the three starved flocks was 93.8 days; of the three fed flocks, 97.4 days.

All this would indicate that the molting process continues much longer than is usually supposed, and that there is considerable variation in the time of beginning the molt between different individuals and between flocks of different ages, also a wide variation in the length of time it requires indivduals to complete the molt. One is further impressed with the fact that, so far as this experiment is concerned, the method of feeding did not materially alter the normal conditions of molting, except with the 1-year-old fowls.

Influence of prolificacy on the time and rapidity of molt.—Persistent layers, unless broody, appeared to begin the molt within a week after the last egg, and were usually in heavy molt in less than two weeks. Those beginning to molt after October 1 shed more quickly and refeathered more quickly than those

molting earlier, especially to the stage of advanced molt, when their bodies were well protected. Hen No. 61 was a good example. It was fifty-six days from the time she began to shed until she had grown a complete coat of feathers.

Influence of broodiness on the molt.—Broodiness influenced the time of molt to a great degree. In this experiment a number of hens became broody, and were allowed to sit for periods varying from three or four days to four weeks. In no instance did a hen shed more than a few feathers while broody. Some hens which had begun to molt and had subsequently become broody ceased molting until broken of broodiness. When broken up they began to molt quickly, and shed and refeathered rapidly and completely.

Production is the real test of a method of feeding. The starved hens averaged 17.3 eggs from the close of their individual molt to April 1, while the fed hens averaged 16.6 eggs during the same period, an average in all the flocks of 16.9 eggs. The yearly production was, however, not in favor of the starved hens, which gave only 102 eggs per year, while the fed hens laid 119 eggs each in the same period.

It is considered important that hens should quickly resume production after molt. In this experiment, the average days after molt before production began was, in the trap-nested flocks (65 hens), thirty-nine days after the completion of the individual molt. The starved hens began to lay in thirty-five days and the fed hens in forty-four days, or nine days later.

The question naturally arises whether hens tend to molt at the same season in successive years. Careful observations of trap-nested hens (1-year-olds) in the molting season of 1906 and 1907 showed that, of both flocks (65 hens), 78.5 per cent molted at practically the same season in two successive years. Where the hens have been fed in the same way during the two years, 87.5 per cent molted at about the same time. The hens which had been starved one year to hasten the molt, and fed after the usual method the next year, did not molt as early the second year as the first. In other words, the so-called "forced molt" held good for only one season, and possibly delayed molting somewhat the second year.

It is apparent from the platted curves of percentages of egg production and hens molting that early molting causes early decline in the production and that late molting tends to postpone the time of decline. It is also indicated that the older fowls have a tendency to molt later than the younger, and that the fed flocks began to molt considerably later during their second year, 1907, than they did during their first year, 1906. Inasmuch as the same tendency was observed with both starved and fed flocks, it would appear that the lateness of molting in the second year might be due more to the age of the fowls than to the methods of feeding.

Forty-five per cent of the starved hens began to lay at about the same time in 1907 as they did in 1906. With the fed hens it was about 63 per cent. In 1906 (the year of starving) 79 per cent of the starved hens began laying earlier than in 1907, and the entire starved flock averaged twenty-four days earlier in 1906.

Hens that shed late take less time to molt.—In these observations it was found that the hens, from all pens, which began to molt before September 15, averaged one hundred and eight days molting, while those which began after that date molted in eighty-one days. This condition seems, in the case of the 1-year-olds, to be modified by the method of feeding. Of the fed 1-year-olds, the hens which molted early averaged thirty-five days longer in molting than those which molted later; but of the starved 1-year-olds, those which shed early averaged two days less in molting than those which shed later. The 8 hens, from both

of these pens, which began to molt after October 1 averaged eighty-two days molting. In every case where the molt appeared to be uninfluenced by the feeding the late molting hens took less time to produce a new coat of feathers than did those which molted earlier.

Hens that molt early lay more early winter eggs.—The hens molting before September 15 began to lay thirty-nine days after the completion of the individual molt; those molting after September 15 began to lay in forty-three days after they were completely refeathered. The hens which molted before September 15 averaged 17 eggs each from the completion of their individual molt to April 2, 1907, while those molting later gave 14 eggs each in the same period.

Hens that molt late lay more eggs during the year.—Although the early molting hens laid more winter eggs, they did not lay more eggs during the year. Those beginning to molt before September 15 averaged 103 eggs, and those molting later averaged 126 eggs. The 8 hens which, in 1906, began to molt after October 1, laid in that year 142 eggs each. Two of the 8 hens died in 1907, but the other 6 gave 129 eggs each in 1907, their third year of laying. The best hen, No. 61, laid 213 eggs in 1906 and 175 eggs in 1907, and was the last one to molt in 1906 and 1907. Thus, the later molting hens consumed less time in molting, and laid more eggs during the year; the early molting hens began to lay more quickly after molting, and gave slightly greater winter production.

The early molting hens averaged 3 eggs more in winter when eggs were high than did the late molting hens. For 100 hens this would mean 300 eggs, or 25 dozen. With eggs at 35.5 cents per dozen (average for that period in 1907) this would make an additional profit of $8.87 in favor of early molting, if the additional amount of food consumed on account of the increased production is not considered.

The late molting hens gave 23 more eggs each during the year than the early molting hens. For 100 hens this would be 2,300 eggs, or 191.6 dozens. At 29.3 cents per dozen (average price from August, 1906, to August, 1907) this would amount to $56.13 extra profit for the late molting hens, if extra amount of food consumed is not considered. The comparative profit of the late molting hens over the early molting hens, without considering extra food consumed, would be $56.13 as against $8.87=$47.26. If one should judge from this record, he might conclude that the best laying hens are often latest to molt; therefore, if condition of feeding, age of stock, and environment are similar, the one who kills the late molting hens may be killing the best producers.

Feather-making demands nitrogenous food.—It is generally conceded that the molting period is the most trying time of a fowl's life. In nature the shedding of the feathers and the growing of a new plumage apparently occurs in a period of rest following one of production. This period of molting normally comes with regularity at a certain season of the year, and presumably is primarily a matter of inheritance, and only secondarily due to environment. Environment may, however, modify—i. e., hasten or retard—the natural process. Whatever the condition influencing the molt may be, it appears that the demands of the body for nourishment from which to grow new plumage are great.

In the absence of reliable data as to the best method of feeding fowls during the critical period of the molt, it would seem desirable to follow the practice commonly believed to be correct, namely, to feed liberally on rations which are easy of digestion and rich in protein and oil. Therefore, in addition to the regular rations, such foods as meat, oil meal, and sunflower seed, should be added, or, if already being fed, should be increased in amount. This modified ration is given in order to meet the increased demands of the body for feather-making ma-

terial at a time when the system presumably would be in need of protein to furnish nitrogen for the growth of feathers and oil to supply available heat for the scantily protected body. What is the normal molt? From the facts now at hand regarding the molting of fowls, it seems that the best molt, considering the question of the vitality of the stock, is one when the fowl sheds the old feathers and replaces them in a regular sequence with the new, without leaving the individual at any time in an exposed and defenseless condition, and therefore in danger either from inclement weather or inability to escape from its natural enemies.

When fowls molt naturally and well, one should scarcely be able to notice that the flock is molting, except that the shed feathers are found in large quantities about the place. These hens, however, may not be the most highly developed producers. Just how far man may safely go in his development of the productive powers of the hen, without endangering her life or the vitality of her offspring by artificial conditions, remains to be proved. It would appear that one of the first natural results, as a consequence of an increased egg yield, is a postponement of the time of the molt.

General results and conclusions.—As compared with the fed flocks the starved hens molted slightly earlier and more uniformly; were in somewhat better condition at the end of the molt; molted (average) in slightly less time; gained less above first weight during molt; gained slightly more in weight during the year; resumed production somewhat more quickly after molt; laid a few more eggs during winter; were materially retarded in egg production; produced less eggs after the molt was completed; produced eggs at a greater cost per dozen; consumed slightly less food during the year; had slightly less mortality; showed slightly more broodiness; and paid a much smaller profit.

The general conclusions were that with the methods employed with White Leghorn fowls 1, 2, or 3 years old, it does not pay to "force a molt" by starvation method, and that apparently it is good policy to encourage hens, by good care and feeding, to lay during late summer and fall, rather than to resort to unusual means to stop laying in order to induce an early molt, with the hope of increasing productiveness during early winter, a season which is naturally unfavorable for egg production. In short, it appears wise when hens want to lay to let them lay.

A PORTABLE PANEL FENCE.[a]

In caring for calves, sheep, and swine on the farm it is convenient to have some sort of fence that can be easily moved. The construction of such a fence is described by William Dietrich, of the Illinois station, as follows:

Construct a table 4 feet wide and 17 feet long. (With a little more care and inconvenience a barn floor may be substituted for the table.) At one end of the table and at right angles with the same, nail a piece of straight board, *c*, Figure *A* in the above cut (fig. 5). At the front side of the table, or the side of the workman, nail two blocks *d*, made of 2-inch lumber, so that they are at right angles with *c*, to form supports for the lower board of the panel and the lower ends of the two end crossbars. Then take 2-inch blocks, *f*, *e*, *g*, that are about 2 inches wide and nail them on the table, so that their outside ends are 11 inches from the proposed ends of the panel, and arrange them so that it is 9 inches from the upper side of *d* to the upper side of *f*, 11 inches from the upper side

[a] Compiled from Illinois Sta. Circ. 132 and Wisconsin Sta. Bul. 184.

of *f* to the upper side of *e*, and 14 inches from the upper side of *e* to the upper side of *g*. Next place 6-inch boards 16 feet long (the length of the panel) so that they lie firmly against the upper side of blocks *f*, *e*, *g*, and butt against *c*. This may easily be accomplished by raising the farther side of the table so that the boards will keep their position against the blocks. Also incline the table toward *c*. The crossbars, which have been sawed 40 inches long, are now nailed one across each end and one in the middle, as shown in the cut above. These are to be 6 inches wide and only on one side of the panel, and nailed with 8d. wire nails, which should be clinched. The two end crossbars can rest against the ends of blocks *f*, *e*, and *g* with their sides and against *d* with the ends. Saw out 1 inch deep from the upper edge of each end of the lower board outside of the crossbar. This will make a fence that is 40 inches high when the lower boards rest on the ground. By following the method outlined above the panels will all be of the same dimension and will thus fit the triangles without difficulty.

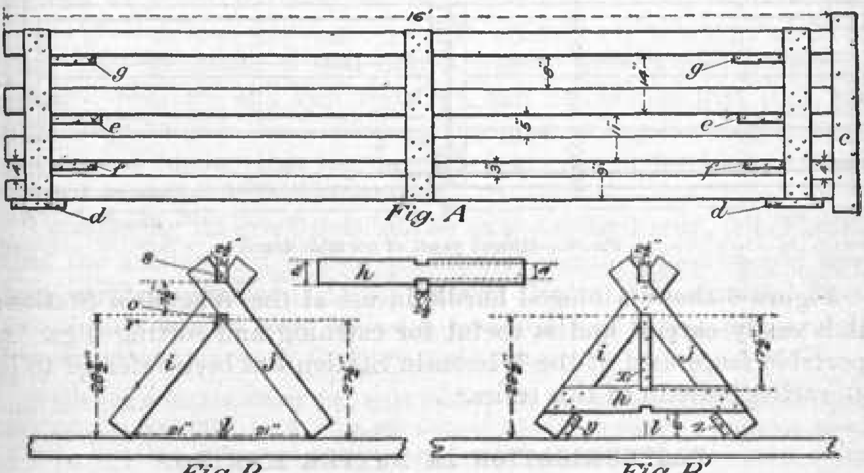

FIG. 5.—Details of construction of portable panel fence.

To construct the triangle represented in B and B′ and used to support the panel, saw three pieces of board 6 inches wide and 4 feet long. Nail a 1-inch board at the front side of the table for a straight edge and use this as a base line. Take a point *l* on the base line and point *o* so that it is 27½ inches above *l* and at right angles to the base line at *l*. Now take two of the boards 4 feet long and lay the lower and inside corners 21 inches from *l* on the base line and allow the inside of the two boards to cross at point *o*. Nail the boards lightly in this position and lay out *r* and *s* which are notches sawed out for the ends of the boards of the panel to fit into. These notches are 2½ inches wide and the upper end of *r* is 28½ inches from the base line. The lower end of notch *s* is 7½ inches above *r*. Now draw out the nails, saw out *r* and *s* and use the two pieces *i* and *j* for patterns. For *h* take a 6-inch board 4 feet long and at the middle of each side saw out a notch 1 inch deep and 2½ inches wide.

After having sawed out a sufficient number of pieces according to Figure B, then proceed to put them together as in Figure B′. Saw out a piece, *x*, 17½ inches long, 2 inches thick, and 2½ inches wide. Nail this on the table so that its median line is perpendicular to the base line at *l* and so that the upper end

is 28½ inches from the base line. Now prepare two blocks *y* and *z* of 1-inch lumber and nail them to the table so that the outside lower points, as in Figure B′, are each 21 inches from the point *l*. Place *i*, *j*, and *h* in the position as in Figure B′ so that the inside notches of *i* and *j* will rest firmly against the upper end of *x* and that the notch on the upper side of *h* will rest firmly against the lower end of *x* and that *h* is parallel to the base line. Nail firmly and saw the corners of *h* so that it is flush with *i* and *j*. The upper ends of *y* and *z* have nothing to do with determining the lower line of *h*. Use 8d. wire nails and clinch.

Both the triangles and panels should be made of common rough fencing and the number of triangles should equal the number of panels plus one. In placing the panels and triangles to make a fence, reverse every alternate panel so that the crossbars are on opposite sides and set a triangle at every juncture of the panels and at the ends of the fence.

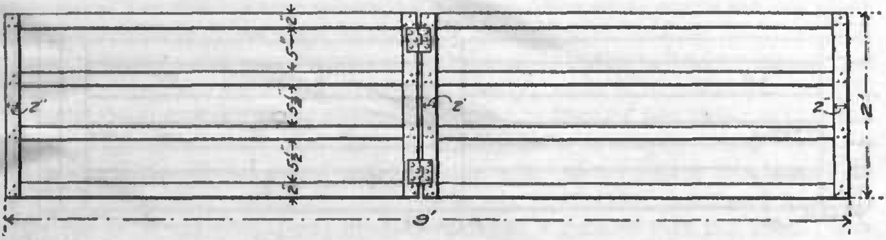

FIG. 6.—Hinged panel of portable fence.

Figure 6 shows a hinged hurdle in use at the Wisconsin Station; it is easily carried and is useful for catching and sorting pigs. A portable fence used at the Wisconsin Station has been referred to in an earlier bulletin of this series.[a]

PASTEURIZATION IN BUTTER MAKING.[b]

According to C. E. Lee, of the Illinois Experiment Station, the change from the whole milk to the cream gathering system in butter making has resulted in a decline in the quality of butter. Pasteurization of farm-skimmed cream has been advocated as a means of improving the quality of butter manufactured in creameries from farm-skimmed cream, but the studies which have been carried on for several years by the Illinois Station have indicated that pasteurization does not affect the body or texture of butter, nor does it improve the quality of butter made from sour farm-skimmed cream. The curdling of cream by pasteurization increases the loss of fat in the buttermilk. It is further shown that pasteurization of sour cream produces a buttermilk of watery appearance.

[a] U. S. Dept. Agr., Farmers' Bul. 78, p. 12.

[b] Compiled from Illinois Sta. Bul. 138.

MILLING AND BAKING TESTS WITH DURUM WHEAT.[a]

Durum wheats have assumed an important place in American agriculture in recent years and have been studied by a number of the agricultural experiment stations in the United States and Canada and by the Bureau of Plant Industry of the Department of Agriculture. Such work has been referred to in earlier bulletins of this series.[b]

Durum wheats have been included in variety tests at the Dickinson Substation of the North Dakota Agricultural Experiment Station, at the Nebraska Experiment Station, the Canada Experimental Farms, and the Ontario Agricultural College and Experimental Farm. In discussion of dry-land grains, W. M. Jardine, of the Bureau of Plant Industry of the Department of Agriculture, considers the different wheat groups with reference to this type of farming. His conclusion is that durum wheats have proved themselves drought resistant and rust resistant, and he believes that they will ultimately become the leading spring type in dry-land agriculture. It is stated further that the durum wheat crop in the United States in 1907 exceeded 50 million bushels.

Considering its great possibilities as a standard crop, it is natural that the milling and baking qualities of durum wheat should have been carefully studied. At the Canada Central Experimental Farm two durum wheats were included in a study of wheat quality. In his report of this work C. E. Saunders states:

> While the ordinary Goose (or Wild Goose) can not be recommended for bread baking, the Kubanka [a well-known durum wheat] produced admirable bread, which, however, differs in some ways from that produced from most of the other wheats. The Kubanka dough must be made rather stiff in order that it may not be too sticky to handle conveniently. It rises very well, producing a large loaf of very fine texture and of good form. The crust is somewhat unusual, being of a rich brown color and having a tendency to be thin and tough. The inside color of the bread is quite yellow, but this gives an appearance of richness and can only be objected to on the grounds of prejudice. Taking all its characteristics into consideration, * * * the bread produced from this sample of wheat was of excellent quality.

The quality of all the flours included in this investigation was studied when used for making baking powder biscuits in addition to yeast-raised bread, and all, including the durum flours, produced bis-

---

[a] Compiled from North Dakota Sta. Bul. 82; Special Bul. 19; Rpt. Dickinson Substa. (1908), pp. 4, 9, 24, and 27; Utah Sta. Bul. 103; Nebraska Sta. Bul. 109; Annual Rpt. of Maryland Agr. College, 34 (1908), pp. 172, 184; Canada Experimental Farms Rpt., 1907, p. 219, and 1908; Canada Central Experimental Farms Bul. 57; U. S. Dept. Agr., Bur. Plant Indus. Circ. 12.

[b] U. S. Dept. Agr., Farmers' Buls. 186, p. 6; 251, p. 14.

cuits of about the same volume. They varied somewhat in character and considerably in color, but the differences between the different kinds of flour were not so striking as in the case of bread, and it is interesting to note that the author therefore concludes: "The making of ordinary tea biscuits can not be considered a test of the ability of gluten to withstand fermentation or of its power to retain a large quantity of gas produced inside the dough."

R. Stewart and J. E. Greaves, at the Utah Experiment Station, studied the milling qualities of common bread varieties and durum wheats grown locally, including 21 samples grown under irrigated conditions and 70 samples grown under arid conditions.

The average weight of 100 kernels of the common bread variety tested was 3.0417 grams and of 100 kernels of durum wheat 3.7258 grams. The wheats were ground in an experimental mill, the bread variety yielding on an average 53.21 per cent flour, 35.11 per cent bran, and 10.91 per cent shorts, and the durum varieties 50.23 per cent flour, 31.97 per cent bran, and 17.27 per cent shorts.

The durum wheats on an average contained 8.89 per cent water and the bread varieties 8.46 per cent. The average protein contents were, respectively, 18.82 per cent and 18.44 per cent, using the factor 6.25, or 17.14 per cent and 16.76 per cent, respectively, if the factor 5.7 is used. The water and protein content of the flour, bran, and shorts of the different kinds of wheat are reported. The proportion of wet gluten, dry gluten, the ratio of wet to dry gluten, the gliadin content, the glutenin content, the proportion of protein in the form of gliadin, the acidity, and the ash content of the different samples of flour were also studied.

According to the authors' summary, the Utah wheats are characterized by a low water content and a protein content much above the average. The percentage of protein in wheat grown on irrigated lands was lower than that of wheat grown on arid farms.

The protein content of the common bread varieties is nearly equal to that of the durum varieties, the difference being only 0.5 per cent. The durum wheats are heavier, kernel for kernel, than the bread varieties.

There are noticeable variations in the yield, milling, and chemical characteristics of the same varieties of wheat grown on the various arid farms of the State. The moist and dry gluten content of Utah wheats is very high. The bran and shorts produced from the common bread varieties of wheat are fully as nutritious as the bran and shorts produced from the hard varieties of wheat.

If the gluten content determines the value of durum wheats for the making of macaroni, the common bread varieties grown in Utah should be just as valuable for this purpose.

The gliadin content of durum wheat is slightly higher than that of the soft varieties.

No single variety now possesses, combined, the desired characteristics of yield, protein content, flour yield, weight per bushel, and the most desirable

milling qualities. However, sufficient evidence is presented to indicate those varieties which it will be most profitable to use for selection in order to obtain the desired results.

The work at the North Dakota Station and at the Dickinson Substation, reported by E. F. Ladd and L. R. Waldron, and in part summarized by Professor Ladd and Emily E. May, is extensive and has yielded interesting results in respect to yield and baking quality of durum wheats in comparison with other varieties. When 15 samples of Fife and Bluestem wheats were compared in milling tests with an equal number of samples of durum wheats, all the varieties being locally grown—

the durum gave a rather larger percentage of flour than did the Fife and Bluestem, and the average weight per bushel for clean wheat was greater, yet the amount of high-grade flours was in favor of the Fife and Bluestem. * * *
It takes slightly less durum to produce a barrel of flour than of Fife and Bluestem. The percentage of bran is less in the durum than in Fife and Bluestem, but the proportion of shorts is higher.

In another comparison it is found that the yield of patent flour of good quality from durum wheat was 74.4 per cent, the first clear flour 22.7 per cent, and the second clear 2.9 per cent. The total yield of the flour was 70.7 per cent of the wheat milled, or somewhat less than in the test just referred to, but about the same as the yield obtained with Fife and Bluestem wheats. "It required 4 bushels and 38 pounds to produce a barrel of flour."

According to Professor Ladd the gluten tests with the different sorts of wheat show that—

the differences in expansive properties are particularly marked between the several grades of flour. The introduction of the first clear into the patent, or the lengthening out of the patent, as is often done, must necessarily result in decreasing the expansive properties. When the patent and first clear are united and sold as straight, or, as is more often done, bleached and sold as patent, or, at least, in place of patent, we can not wonder at the lowering of strength now generally recognized in many brands of flours.
The expansive properties of the durum gluten are not equal to that from the Fife, as indicated in these tests, and this is further borne out in the baking tests with the two flours. The physical properties of the gluten from a patent or first clear also differ in many other respects not clearly indicated by the above tests, but soon recognized by one who is engaged in washing out glutens.

Professor Ladd points out that the analyses of the flour samples ground from the durum wheats in general have shown higher percentages of total protein than found in Fife and Bluestem wheats. The analyses of the flours do not average as high for the same grade of durum as for other wheats. On the other hand, analyses of previous years have shown the reverse order, but more markedly is this noticeable by comparing the analyses above given with the average for commercial flours in North Dakota markets.

From baking tests which were made with flours ground at the North Dakota Experiment Station and from commercial samples, it appeared, according to Professor Ladd, that—

the volume of the loaf for the commercial flours averaged quite a considerable above that of the test flours produced at the college. It should be said also that when several of the mill flours were blended better results were secured in bread production than where the individual samples were tested alone.

As regards the gluten tests made with the commercial flours, the results show less of wet and of baked gluten for the commercial flour than either of the others, and in expansion the gluten for the commercial flours is less than that produced from Dakota Fife and Bluestem wheats as a patent, but superior to that produced from the durum.

In connection with the work at the North Dakota Station, samples of durum flour were submitted to a large number of housewives for testing for making bread and other flour products. The replies received, together with general conclusions, are summarized by Professor Ladd and Miss May as follows:

It is claimed by the farmers that durum wheat in the western part of the State yields much better than our hard wheats for the same section of the State.

Farmers hold that durum is much more disease resistant than other wheats generally grown in the State.

That durum wheat produces as much straight flour as either Fife or Bluestem in the experiments at the experiment station.

The number of bushels required to produce a barrel of flour is no greater than the average for other wheats.

It is claimed that it takes more power to grind durum than for Fife or Bluestem.

It has been shown that processes of tempering durum may have a marked effect on the flour-producing quality of the wheat.

Bread from durum flour is equal to that produced from the other flours as found on the market.

The bread is not so white as that from the average Fife or Bluestem flour, having more of a creamy appearance.

The consensus of opinion is that the flavor of the bread is equal, if not superior, to that produced from the best commercial flours, being slightly sweeter and having a more nutty flavor.

The bread from durum flour holds the moisture better than that produced from commercial flours.

The general consensus of opinion of those who have tested the flour in bread making is that the bread is equal to that from other flours.

O